THE UNIVERSITY OF TENNESSEE

DEPARTMENT OF ELECTRICAL ENGINEERING

DEVELOPMENT
OF A
HIGH FREQUENCY STEERABLE ANTENNA

INTERIM DEVELOPMENT REPORT NO. 23

10 August 1954

Navy Department — Bureau of Ships
Electronics Divisions
Contract No. NObsr-57448 Index No. NE-091035 ST7

A PROJECT OF THE ENGINEERING EXPERIMENT STATION
THE UNIVERSITY OF TENNESSEE COLLEGE OF ENGINEERING
Knoxville, Tennessee

INTERIM DEVELOPMENT REPORT

FOR

DEVELOPMENT OF A HIGH FREQUENCY STEERABLE ANTENNA

This report covers the period
1 July 1954 to 31 July 1954

ENGINEERING EXPERIMENT STATION
THE UNIVERSITY OF TENNESSEE
KNOXVILLE, TENNESSEE

Navy Department — Bureau of Ships
Electronics Divisions
Contract No. NObsr-57448 — Index No. NE-091035 ST7

10 August 1954

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ABSTRACT

This report covers work done on Contract No. NObsr-57448, Index No. NE-091035 ST7, at The University of Tennessee during the month of July 1954.

The following was accomplished:

1. Work is being continued on calculation of the total field $\left(\sqrt{E_\theta^2 + E_\phi^2}\right)$ for the horizontal patterns of the vertically stacked rhombic arrays.

Experimental work has begun on the so-called "closed rosette" array of rhombic antennas.

2. A theoretical radiation pattern has been calculated for two concentric circular traveling wave antennas with the ratio of circumferences being $C_1/C_2=2$, and with a current ratio of $I_1/I_2=1$. The first draft of the detailed report on the circular traveling wave antenna has been written and corrected.

PART I

Purpose

This project involves the development of a high frequency steerable antenna having the following characteristics:

1. It shall be operable throughout the frequency range of 4 to 32 megacycles per second.

2. It shall be capable of four, or more, simultaneous transmissions on different frequencies, and at different azimuth and elevation angles.

3. For each transmission, it shall be capable of being directed to any azimuth angle and to any elevation angle between the horizon and 30^{o} above the horizon.

The communication system shall provide reliable 24-hour day-to-day communication with a 20-decibel signal-to-noise ratio. The ranges to be covered are from approximately 500 nautical miles to 4000 nautical miles.

The development consists of two phases:

Phase I. Theoretical and experimental studies.

Phase II. Development of design criteria.

General Factual Data

Personnel:

F. V. Schultz	Project Director	59	Man-hours
W. J. Bergman	Junior Engineer	128	Man-hours
C. E. Blakely	Junior Engineer	32	Man-hours
H. P. Neff	Junior Engineer	168	Man-hours
J. J. Elson	Technical Editor	2	Man-hours
H. W. Fuller	Translator	22	Man-hours
Cornelia Cate	Secretary	49	Man-hours
L. Phillips	Technician	76	Man-hours
P. Alfrey	Student Computer	126	Man-hours
B. Bodenheimer	Student Computer	15	Man-hours
D. Guhne	Student Computer	7	Man-hours
H. Knox	Student Computer	73-1/2	Man-hours
G. Rolfe	Student Computer	56-1/2	Man-hours
T. Simpson	Student Computer	116	Man-hours
G. C. Watkins	Student Computer	12	Man-hours

References

Harper, A. E., Rhombic Antenna Design, D. Van Nostrand Co., Inc., New York, 1941.

Jordan, Edward C., Electromagnetic Waves and Radiating Systems, Prentice-Hall, Inc., New York, 1950.

Kraus, J. D., Antennas, McGraw-Hill Book Co., New York and London, 1950.

McLachlan, N. W., Bessel Functions for Engineers, Clarendon Press, Oxford, 1934.

Terman, F. E., Radio Engineers' Handbook, McGraw-Hill Book Co., New York and London, 1943.

Watson, G. N., Theory of Bessel Functions, Cambridge University Press, Cambridge, 1922.

Detailed Factual Data

1. Work has begun on preparation of the antenna test site in order to facilitate pattern measurements of the "closed rosette" array of rhombic antennas. Considerable modification of the present equipment is required to make these measurements possible, due to the large physical size of the antenna array and the higher frequencies required.

2. A theoretical radiation pattern has been calculated for two concentric circular traveling wave antennas with the ratio of circumferences $C_1/C_2 = 2$, and the ratio of currents $I_1/I_2 = 1$. This pattern did not show any appreciable reduction in side lobe levels. Patterns are being calculated for other circumference and current ratios.

Theoretical calculations of the vertically polarized component of the electric intensity, E_θ, and the total electric field $\sqrt{E_\theta^2 + E_\phi^2}$, are being carried out for a single antenna.

The detailed report on the circular traveling wave antenna has been corrected and rewritten, and is now ready for proofreading by the Technical Editor. Some delay in the completion of this report is anticipated because of responsible personnel being on vacation.

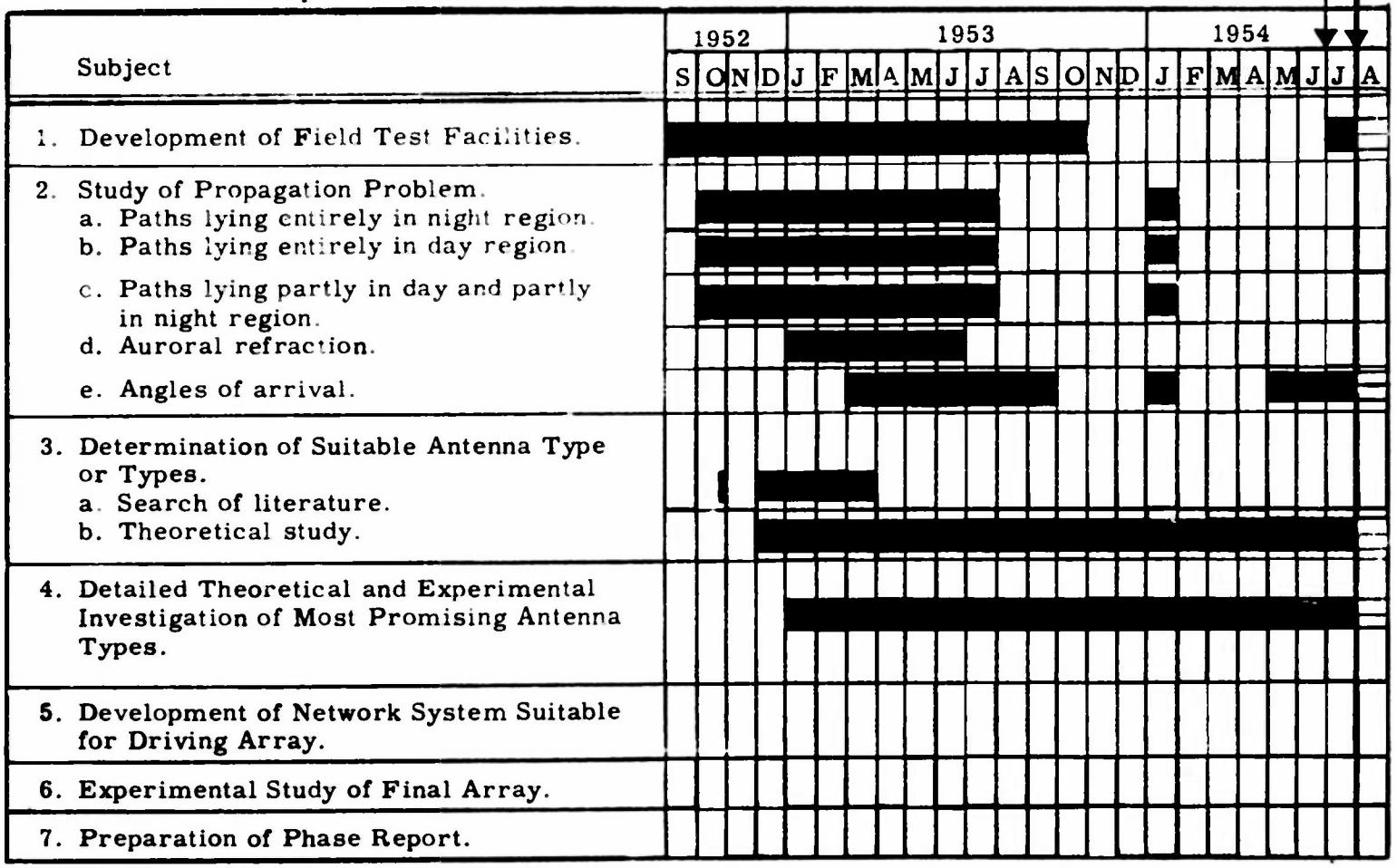
DEPARTMENT OF ELECTRICAL ENGINEERING - ENGINEERING EXPERIMENT STATION
THE UNIVERSITY OF TENNESSEE

PROJECT PERFORMANCE AND SCHEDULE

Index No. NE-091035 ST7

Contract No. NObsr-57448
Legend: ▬ Work Performed
═ Schedule of Projected Operation

Date: 10 August 1954
Period Covered: 1/7/54 to 31/7/54



Conclusions

None.

PART II

Program for Next Interval

1. Horizontal patterns for stacked rhombic arrays will continue to be calculated for both the phi-polarized and theta-polarized components of the radiated field.

Preparation of the test site for measuring the radiation patterns of the "closed rosette" array of rhombic antennas will continue.

2. Work will be continued on the preparation of a detailed report on the circular traveling wave antenna. The investigation of the field from two concentric antennas will be continued. Additional theoretical and experimental patterns will be obtained.